Effects of forest stand structure on population of endangered orchid species *Cypripedium calceolus* L.

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INTRODUCTION

- Orchids are especially prone to a variety of threats, including habitat loss, illegal harvesting, land-use changes, as well as climate changes;
- Populations of ***Cypripedium calceolus* L.** as a lot of other orchid species had undergone a severe decline;
- Despite good knowledge about *C. calceolus* biology, only a few studies have dealt with the relationship between forest structure or forest management and this species;

AIM

The main aim of this study was to analyze the relationship between the occurrence of the *C. calceolus* ramets and variables related to fo stand structure (e.g. distance to crown or stem of a tree, basal area, density of trees and tree saplings). Additionally, the morphometrics of the individuals were also taking into consideration.

QUESTIONS

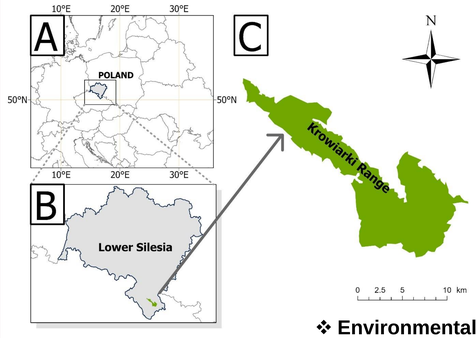
1) What is the relationship between the distribution of trees and ramets of *C. calceolus*?

2) Is the distribution of *C. calceolus* affected by the presence of canopy gaps or tree saplings?

3) How does forest stand structure affect flowering and morphometric features of *C. calceolus* ramets?

METHODS

❖ Study area – Krowiarki Range



A – in Central-Europe

B – in district of Poland

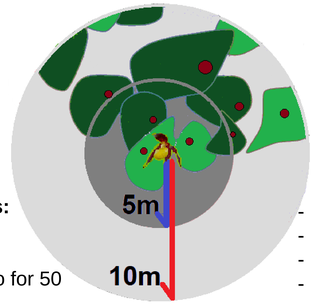
C – study side (Natura 2000)

❖ Field sampling

❖ Vegetation season 2019 and 2020

1. Exploration and population inventory
2. *C. calceolus* morphometric mesurments
3. Mapping main population (by FieldMap)
   - C. calceolus distribution
   - forest stand (spatial distribution of trees, crow projection, DBH, sapling density)

Basis on this we created environmental variables



❖ Environmental variables:

Calculated in addition to *C. calceolus* individuals also for 50 random points.

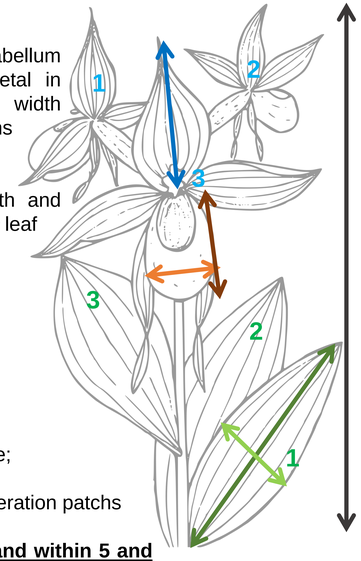
- Distanse to nearest tree
- Basal area of trees
- Canopy gaps
- Maximum DBH of the tree;
- Distance to tree crown;
- Localization inside regeneration patchs
- Etc.

Variable by tree species and within 5 and 10 radius metres of each *C. calceolus*

❖ Flowers: number, labellum and upper petal in the perianth width and the lengths

❖ Leaves: number, length and width of every leaf

❖ Height



❖ Statistical analyses

We used in a multivariate logistic regression model. The strategy for model building was to (1) remove multicollinearity of the variables and (2) choose the subset of candidate predictors, finding the best model based on the Akaike Information Criterion (AIC) in a backward stepwise elimination method, implemented in the stepAIC function.

The effects of all continuous predictors were tested separately in one-dimensional logistic regression models. The response curves of the models with the lowest Bonferroni-corrected p values of the regression coefficients were plotted. Finally, we tested the correlations between the morphometric parameters (dimensions of leaves, ramet height and number of flowers) and environmental predictors using Bonferroni-corrected p-values of the t-test for correlation.

RESULTS

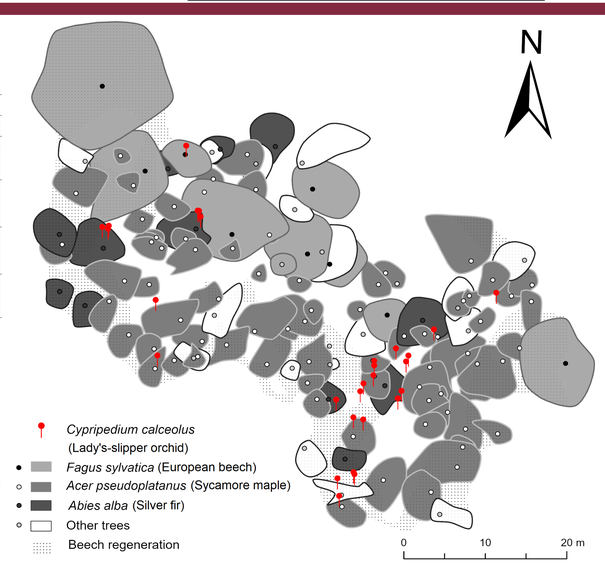
Variable	Label	Estimator	SE	z-value	p
(Intercept)		2.653	2.308	1.149	0.001**
Distance to nearest fir stem	DIST_TO_Abies	-0.567	1.174	-3.264	0.001**
Basal area within 5 m radius	BA_5m	-5.160	1.902	-2.713	0.006**
Basal area within 10 m radius	BA_10m	-1.376	0.593	-2.321	0.0203*
Maximum DBH within 5 m radius	MAX_DBH_5m	0.100	0.492	2.044	0.0409*

❖ We measured 114 trees around 34 *C. calceolus* ramets;

❖ The probability of the presence of *C. calceolus* decreased with the distance to fir trees and with an increase in the basal area, but increased with maximum DBH in 5 meters buffer zone (see table);

❖ The ramets growing close to European beech or sycamore maple had slightly lower leaf dimensions than the ramets in the surroundings of fir an a pattern of decreasing leaf size with proximity to beech or sycamore was visible;

❖ The flowers did not show any relationship with environmental variables.



CONCLUSIONS

❖ The forest stand structure plays an important role in spatial distribution of *C. calceolus* ramtes;

❖ The strongest positive effect of silver fir can be related to water and moisture conditions;

❖ Negative impact of European beech on *C. calceolus* can be explained by light conditions and stemflow;

❖ The results of this research mayhelp to tune-up forest management and protect this rare orchid.

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